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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/651,871 08/31/00 DONOHUE

K 11675.185

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IM52/1107

EXAMINER

VINH, L

ART UNIT

PAPER NUMBER

1765

DATE MAILED:

11/07/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/651,871

Applicant(s)

DONOHOE ET AL.

Examiner

LAN VINH

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 August 2000.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-39 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-39 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 5) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 6) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 23 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 23 recites the limitation "polymer forming gas" in claim 5. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 3, 5-9, 11-12, 17, 19-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Kumihashi et al. (US 5,368,685)

Kumihashi discloses a method for dry etching semiconductor substrate. This method comprises the steps of:

providing an etch treatment chamber and a semiconductor/microelectronics substrate disposed in the chamber (col 9, lines 5-7)

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introducing an etchant gas of chlorine /gas suitable for forming a deposit into the etch chamber in a pulse shape at the timing as shown in fig. 7, fig. 7 depicts the pulsing of the etchant gas varies with the flow rate for a plurality of period of times (col 13, lines 54-60 and fig. 7)

etching the semiconductor/microelectronics substrate with pulsing chlorine gas (col 15, lines 16-18)

Regarding claim 6, Kumihashi discloses using high density plasma chamber/etching tool (col 5, lines 66-67)

Regarding claim 7, Kumihashi discloses forming a silicon oxide layer/film (col 10, lines 25-26)

Regarding claims 8-9, fig. 8 of Kumihashi shows that the etchant gas is pulsed so that the gas is turned on and off in a plurality of period of time that reads on pulsing the gas so that the gas reaches/does not reach steady state concentration in the chamber.

Regarding claim 12, Kumihashi discloses flowing a second gas of oxygen and inert gas into the chamber (col 6, lines 36-37 ;col 15, lines 39-40)

Regarding claim 17, Kumihashi discloses forming a resist layer on the silicon substrate (col 3, lines 28-29)

Regarding claim 19, fig. 12(d) of Kumihashi shows the etching stops on silicon layer
37

Regarding claim 22, Kumihashi discloses the etchant gas removes a portion of oxide layer 36 (col 15, lines 14-16)

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Regarding claim 23, Kumihashi discloses that the etching gas forms an oxide deposit served as a sidewall protection film (col 16, lines 37-40), forming an oxide layer on the substrate (col 10, lines 25-26)

5. Claims 35, 38-39 are rejected under 35 U.S.C. 102(b) as being anticipated by Kumihashi et al. (US 5,368,685)

Kumihashi discloses a method for dry etching semiconductor substrate. This method comprises the steps of:

exposing a substrate to oxygen gas and chlorine gases/plurality of gases , the chlorine gas is introduced into the chamber in a pulse shape at the timing as shown in fig. 7, fig. 7 depicts the pulsing of the etchant gas varies with the flow rate for a plurality of period of times (col 13, lines 54-60 and fig. 7), chlorine gas is an etchant gas and oxygen gas forms an oxide film/protective layer (col 15, lines 30-50)

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 2, 10, 13, 14, 16, 18, 25-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumihashi et al (US 5,368,685) in view of the following:

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Kumihashi's method has been described above in paragraph 4. Unlike the instant claimed inventions as per claims 2, 10, 13, 16, Kumihashi does not specifically disclose the specific duty cycle, flow rate, etch selectivity ratio. However, in a method of pulsed plasma etching, etching parameters such as duty cycle, flow rate affect the amount of material removed from the substrate by etching/etch selectivity ration. It would have been obvious to adjust the flow rate, duty cycle by optimizing the same by conducting routine experimentation for the purpose of obtaining the best etch selectivity ratio.

Regarding claims 18, 25-26, since it is known in the art to employ silicon nitride layer as an etch stop layer, it would have been obvious to modify Kumihashi by forming a nitride layer/ etch stop layer on the substrate to protect the substrate during etching step.

8. Claims 4, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumihashi et al (US 5,368,685) in view of Hanazaki et al. (US 6,287,980)

Kumihashi's method has been described above in paragraph 4. Unlike the instant claimed inventions as per claims 4, 15, Kumihashi does not specifically disclose controlling the pulsing with one piezoelectric valve.

However, Hanazaki discloses a plasma processing method comprises the step of controlling the gas pulsing with a piezoelectric valve (col 14, lines 54-55)

Hence, one skilled in the art would have found it obvious to modify Kumihashi by using the piezoelectric valve to control the gas pulsing as per Hanazaki especially

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because Hanazaki teaches that a gas output can be pulsated by pulsating current supplied to the electromagnetic coil in the piezoelectric valve (col 14, lines 60-62)

9. Claims 27-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanazaki et al. (US 6,287,980) in view of Lu et al. (US 5,429,978)

Hanazaki discloses a plasma processing method comprises the steps of:

disposing a patterned semiconductor substrate in a high density plasma chamber, the substrate comprising a silicon layer, an oxide layer (col 16, lines 29-32 ; col 24, line 20)

etching to remove portion of oxide layer 56 by pulsatively introducing CF_4 fluorocarbon into the chamber (col 26, lines 24-33) ; the flow rate of CF_4 gas varies for a plurality of time as the gas is pulsed (fig. 13A), the fluorocarbon gas forms C-H deposits/protective layer (col 26, lines 66-67), removing the etching reaction product/polymer from the substrate (col 17, lines 25-26)

Unlike the instant claimed invention as per claim 27, Hanazaki does not specifically disclose the substrate comprises a gate structure being encapsuled by SiN.

However, Lu discloses a method of forming a self-aligned stack comprises the step of etching a gate stack structure encapsuled by SiN using fluorocarbon etchant (col 4, lines 16-25)

Since Lu discloses etching a gate stack structure using the same etchant as Hanakaki, it would have been obvious to modify Hanazaki by forming a gate stack structure on the substrate as per Lu because Hanazaki is not particular about the type

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of structure formed on the substrate; therefore, any structure includes a gate stack structure would have been anticipated to produce an expected result.

Regarding claims 28-29, Hanazaki discloses pulsing the gas of CHF_3 into high density etch chamber for a plurality of period of time (col 26, lines 32-35)

Regarding claim 30, Hanazaki discloses pulsing the etchant with a piezoelectric valve (col 14, lines 54-55)

10. Claims 31-34, 36-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanazaki et al. (US 6,287,980) in view of the following:

Hanazaki discloses a plasma processing method comprises the steps of:

forming a photoresist pattern on a semiconductor substrate includes an oxide layer and a TiN/nitride layer disposed on a silicon layer (col 16, lines 29-40; col 23, lines 33-35)

disposing the substrate in an etch chamber (col 16, lines 9-10); pulsing BCl_3 gas/sedimentary gas into the etch chamber to form a deposit of boron nitride/metal nitride (metal) film (col 21, lines 65-67)

the flow rate of BCl_3 gas varies for a plurality of time as the gas is pulsed (fig.13 A)
introducing the time varying flow rate of BCl_3 into the chamber in the ranges between 20 sccm and 80 sccm (col 23, lines 65-66)

etching the semiconductor substrate with pulsed CF_4 /fluorocarbon gas (col 26, lines 26-30), etching to remove portion of oxide layer 56 by pulsatively introducing CF_4

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fluorocarbon into the chamber, the etching stops on the silicon layer (col 26, lines 24-33 and fig. 8B)

Unlike the instant claimed inventions as per claim 31, Hanazaki does not specifically disclose the specific duty cycle range. However, in a method of pulsed plasma etching, etching parameters such as duty cycle, flow rate affect the amount of material removed from the substrate. It would have been obvious to adjust the duty cycle by optimizing the same by conducting routine experimentation for the purpose of obtaining the best etching rate.

Regarding claims 32-33, fig. 13A of Hanazaki shows that the etchant gas is pulsed so that the gas is turned on and off in a plurality of period of time that reads on pulsing the gas so that the gas reaches/does not reach steady state concentration in the chamber.

Regarding claim 34, Hanazaki discloses flowing nitrogen and oxygen gases into the chamber (col 22, lines 1-3).

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Nguyen et al (US 5,933,759) discloses using silicon nitride as an etch stop layer (col 5, lines 5-7), etching using fluorocarbon gas provides polymer deposit on the sidewall of semiconductor structure (col 6, lines 57-60)

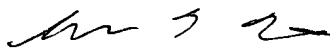
Heinecke et al (US 4,935,661) discloses pulsed plasma etching using variables/parameters such as duty cycle, flow rate (col 9, lines 12-15)

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to LAN VINH whose telephone number is 703 305-6302. The examiner can normally be reached on Monday-Friday 8:30 -6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, BENJAMIN L UTECH can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 305-3599 for regular communications and 703 305-3599 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308-0661.


BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700

LV
November 6, 2001